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(54) Title: PROCESS FOR CHARGED PARTICLE BEAM MICRO-MACHINING OF COPPER

(57) Abstract: A micro-machining process that includes etching a substrate having copper overlying a dielectric layer to a charged particle beam in the presence of an etch assisting agent. The etch assisting agent is selected from the group consisting of ammonia, acetic acid, thiolacetic, and combinations thereof.

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L21/3213

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EDINGER K: "Gas assisted etching of copper with focused ion beams" JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B, vol. 17, no. 6, November 1999 (1999-11), pages 3058-3062, XP002229082 the whole document ---	1,4, 14-20,23
X	US 5 336 363 A (MORITA KATSUMI) 9 August 1994 (1994-08-09) column 2 --- -/--	1,5,6,8, 9,14-22

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Szarowski, A

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International Application No
PCT/US 02/27178

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	IGARASHI Y ET AL: "DRY ETCHING TECHNIQUE FOR SUBQUARTER-MICRON COPPER INTERCONNECTS" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, ELECTROCHEMICAL SOCIETY. MANCHESTER, NEW HAMPSHIRE, US, vol. 142, no. 3, 1 March 1995 (1995-03-01), pages L36-L37, XP000504886 ISSN: 0013-4651 the whole document	1,4, 8-12, 14-22
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 074 (E-1036), 21 February 1991 (1991-02-21) & JP 02 295117 A (NIPPON TELEGR & TELEPH CORP), 6 December 1990 (1990-12-06) abstract	1,4, 14-22
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 479 (C-0992), 6 October 1992 (1992-10-06) & JP 04 173988 A (NISSIN ELECTRIC CO LTD), 22 June 1992 (1992-06-22)	1,4, 14-22
A	abstract	2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 02/27178

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5336363 A	09-08-1994	NONE	
JP 02295117 A	06-12-1990	JP 2732663 B2	30-03-1998
JP 04173988 A	22-06-1992	NONE	